

AMENDMENTS TO THE SPECIFICATION

Please make the following amendment to the specification on page 3, lines 16-22:

A1 Optically-pumped solid-state lasers that have applications in metallurgy where the precise cutting of very hard materials is needed, and in mining of minerals ~~has~~ have the disadvantage of frequent breakdown and damage at higher power levels because of the intense heat generated within the laser material and by the pumping lamp. This handicap eliminates this kind of laser from applications which are subject to intense temperature variations. The optically-pumped solid-state lasers also suffer from the drawback of a very narrow tuning range of less than 50 GHz.

Please make the following amendment to the specification on page 6, lines 1-10:

B2 The present invention is a method and apparatus for using ring resonators to produce narrow linewidth hybrid semiconductor lasers. According to one embodiment of the present invention, the narrow linewidths are produced by combining a semiconductor gain chip with a narrow pass band external feedback element. The semi conductor laser is produced using a ring resonator which, when combined with a Bragg grating, acts as the external feedback element. According to another embodiment of the present invention, the proposed integrated optics ring resonator is based on plasma enhanced chemical vapor deposition (PECVD) silicon-oxide/silicon-oxynitride/silicon-oxide ($\text{SiO}_2/\text{SiON}/\text{SiO}_2$) waveguide technology.

Please make the following amendment to the specification on page 9, lines 21- page 10, line 2:

B3 According to another embodiment of the present invention, the external feedback elements use Bragg gratings with a resonate optical reflector, which ~~is~~ are formed by the coupling and the periodic variation of the refractive index in the core region or cladding of two Bragg gratings.

B3
This is depicted in Figure 1, where substrate 100 is the bottommost layer followed by lower cladding layer 130. Core 110 is sandwiched between upper cladding 120 and lower cladding 130. The spatial period of the modulation is related to the desired center wavelength through an effective mode index.

Please make the following amendments to the specification on page 18, lines 5-12: _____

B4
Line narrowing depends on the sharpness of the reflectivity peak as well as waveguide losses, reflectivity at the interface between the semiconductor die and the external feedback element, and mode mismatch losses. Using the mathematical treatment developed by R. Kazarinov (see reference above), and given a waveguide ~~loss~~ loss of 0.2 dB/cm, a mode mismatch ~~loss~~ loss of 1 dB and an interface reflectivity of 3% (0.13 dB), the ring resonator external feedback may provide a linewidth reduction factor F^2 of up to 8000. This is more than enough to convert a gain chip with 50 MHz linewidth into a laser with a 10 KHz linewidth. This is comparable to the Nd:YAG lasers currently being used in the field of metrology.
